Bulk Method of Hardwood Cutting Propagation of *Larix olgensis*

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Abstract: *Larix olgensis* is a major reforestation species in areas of the northeast part of China. Rooted cutting for vegetative propagation on this Larch has been carried out since 1990, and later the bulk method of hardwood cutting propagation also has been studied. The result is as follows: (1) Cuttings from physiologically juvenile trees are easy to root, and develop better roots. In addition, there are many methods to enhance the cuttings' rooting. (2) The good time for seedling transplanting is in the middle of August. Treatments with plant hormones and rare-earth compounds can improve the seedling' survival rate, and the survival rate of the seedlings soaked in chelate rare-earth molybdenum compound (300×10^{-6}) for 3 hours reached 94.00%, 19.49% higher than that of the control. (3) Methods of maintaining juvenility such as hedging, is essential to further developments for operational planting of vegetative propagates. Hedges in 5 years old can produce 91.75 shoots per tree, exceeding the control to 152.2%.

Key words: *Larix olgensis*, Cutting propagation, Seedling transplanting, Hedge plot

Introduction

Changbai Larch (*Larix olgensis*), traditionally, is a species by seed propagation. It dose not consistently produce seeds in high yield every year, so that high quality seeds from the seed orchards can not meet the needs of reforestation in large area. For this reason, a study on cutting propagation of this species has been carried out since 1990, but the results were not quite ideal because of lacking experience of cutting propagation technique, less young trees, as well as poor management technique, and so on.

From 1994, large-scale research of cutting propagation of this species, on the basis of the first experiment, has progressed, that includes softwood and hardwood cutting propagation method, rooting mechanism of the cuttings, transplanting technique of the cutting seedlings, so the hedge plot has been also established. Some good results of the rooting technique and mechanism have been reported. This time, our discussion will center on how to improve the seedling's survival after transplanting, and how to manage the hedge plots. Anyway, this is only a primary result and a further study will be needed.

Materials and Methods

Cutting sources

2-5 years old cuttings were all from the hedge plots in the nursery, and over 5 years old cuttings came from plus tree of the Larch plantation and provenance trial plots at the Forest Experiment Station of Maoer Mountain of Northeast Forestry University.

Leafy cuttings were collected from the first and second order lateral shoots, 8-10 cm long, at the end of May. After collection, the cuttings were kept moist and transported with the basal ends soaked in water in order to prevent drying out of the cuttings.

Cutting propagation method

Cuttings were inserted into outside sand bed to a depth of 2-3 cm and at 3 cm ×4 cm spacing, following trimming of the basal end. Watering was carried out by an automatic mist system. In some special test, the cuttings were soaked for vary duration, in aqueous solutions of several plant hormones at deferent concentration before inserting.

A randomized block design with 60-200 cuttings per plot and three replications was used. All cuttings were recorded for rooting rate at intervals for three months. The percentage was subjected to arsine transformation before statistical analysis.

Seedling transplanting

The rooting seedlings were transplanted into humus soil in the nursery. In order to ensure seedling's survival, some of them were treated in aqueous solutions of plant hormones and rare-earth compounds before transplant-

ing. Survival rate of the seedlings was measured next spring.

Establishing and managing hedge plots

The hedge plot is located in the station nursery. Some hedges were from excellent seedlings that the seeds were selected from good Provenance in the nursery. The clonal hedges came from grafts of the hybrids of deferent Larch species, which were collected from the clonal test. Both of budding and approach graft were used to produce the hybrids' hedges.

To increase production of the cuttings in the plots, the donor trees were hedged in deferent height, such as short type in 20 cm, middle type in 60 cm and high type in 100 cm, in which all lateral shoots were kept in 4-5 cm long.

Result and Discussion

Rooting technique of the cuttings

Normally, Larch is a species that is difficult to root by cutting propagation. From 1977, a number of researches on rooting technique of Larch were started in the country, and some successful methods were introduced. In our experiments, some good results have been achieved, and a brief review is as follows:

Firstly, the age of ortet is a most important factor that effected the rooting percentage of the cuttings. Cuttings taken from hedges under 3 years old can be rooted easily, and the rooting rate is more than 90%. When age of the ortet is over 6 years old, a decline in rooting rate could be clearly seen. Based on variance analysis, the ortet age was a significant influence on rooting percentage of the cuttings ($F= 64.11^{**}$).

Secondly, cutting's location on the ortet can also impair rooting rate of the cuttings. The cuttings from low part of the ortet in 4 years old have higher rooting ability. It already reached 90.94%, and then 80.13%, 75.00% in the middle and upper of ortet.

Thirdly, the cuttings treated with plant hormones in certain concentration can improve the rooting rate of the cuttings from older ortet. Basal ends of hardwood cuttings, of age 6 years old, were soaked for 1-3 hours in aqueous solution ($50\text{-}300 \times 10^{-6}$) such as IBA, NAA and ABT_1, with water as a control. The result showed that the treatment of IBA solution was more affective than that of NAA and ABT_1. When the cuttings were soaked in IBA (200×10^{-6}) for 2 hours, the highest rooting rate reached 80.20%, 158% higher than the control. Conversely, the cuttings from younger ortets did not rooted differently much from each other.

In addition, there are other factors that can affect the cutting's rooting, such as genetic quality of ortet, storage method and time of the cuttings, as well as cutting's quality [3, 4].

Transplanting cuttings' seedling

In order to improve the seedling survival after transplanting, the plant hormone ABT_3 and rare-earth compounds were utilized. The results showed that almost all treatments were useful for ensuring the seedling's survival. The survival rate reached 92.60% when basal ends of the seedlings were soaked in ABT_3 (100×10^{-6}), exceeding the control 10.4%.

From Table 1, the result clearly showed that treatments with rare-earth compounds in different concentrations resulted in an increase in the survival rate of the seedlings. The treatment with chelate rare-earth molybdenum was better than that with rare-earth nitrate, in which the survival rate of seedlings treated with chelate rare-earth molybdenum (300×10^{-6}) in 3 hours was 94.00%, 19.49% higher than that of control. The probably reason is that there is chelating agent in rare-earth molybdenum compound, and trace element as molybdenum can be easily sucked up by plant and rapidly spreaded. At the same time, root activity of the seedlings is strengthened.

Table 1. Effect of treatment with different rare-earth compounds on seeding's survival

Treatment(10^{-6}/h)	Survival rate (%)	5% LSR
Rare-earth nitrate (300/3)	77.67	
Rare-earth nitrate (100/3)	78.00	
Control (water)	78.67	
Rare-earth nitrate (200/3)	79.00	
Chelate rare-earth molybdenum (100/3)	79.00	
Chelate rare-earth molybdenum (200/3)	83.00	
Chelate rare-earth molybdenum (300/3)	94.00	

Besides, it could be seen that condition of the root development and transplanting time of the seedlings also played important roles. The better and longer the root development of seedlings was, the more the seedlings survived. Result of the seedlings transplanted from July 30 to August 30 indicated that the middle of August is the best time for transplanting hardwood cutting's seedling (see Fig. 1). The seedling's survival rate will be reduced by early or late transplanting.

Hedge plot

As mentioned before, younger Larch often roots readily, but it is almost impossible to root when they become older. To keep the trees in a juvenile stage, several methods have been tested such as grafting and hedging.

hedging is a good way of not only maintaining juvenility of the donor trees but also increasing the cuttings' production. The result from the trees in 5 years old illustrated that hedged ortets could produce more lateral shoots, and about 91.75 shoots per ortet were obtained, higher 152.2% to the control that the ortets were not hedged (see Fig. 2).

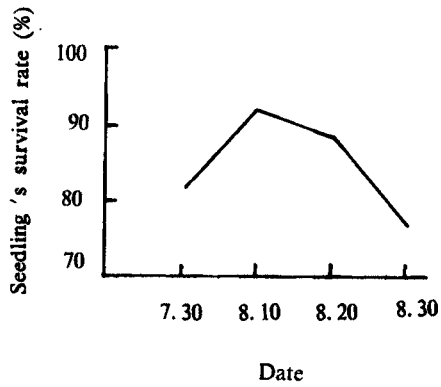

Fig. 1. Effect of different transplanting time on seedling's survival

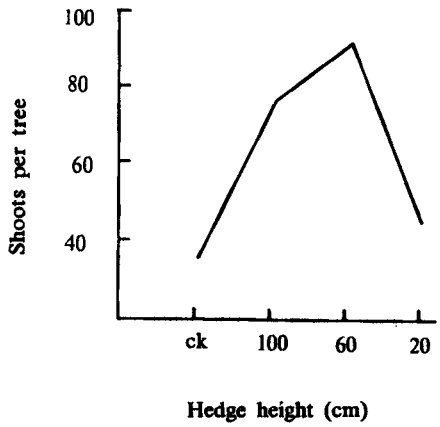

Fig. 2. Effect of hedging method on cuttings' yield

The hedge plot in cutting propagation is the cheapest and simplest method to produce a large amount of high-quality cuttings because the donor plants are young and shoot production is easy to arrange. But, there still is a progressive loss with age of the aptitude for the cuttings' rooting. The same result was shown in our experiment (see Table 2). The younger the ortets was, the more the roots produced. And the cuttings from the hedge plot rooted better than those from the plantation in the same age. In view of this, the best age for cutting propagation of *Larix olgensis* is the donor trees in less 6 years old.

Moreover, the soil fertilized properly can also help the ortet to provide more shoots. Of course, this is only a primary result of hedge management of this species.

Table 2. Rooting ability of the softwood cuttings from hedges plot in different age

Age	Rooting rate (%)	Shoots/tree	Cuttings/ tree
3.5 a (hedge plot)	94.50	14.0	7.2
4.5 a (hedge plot)	88.30	46.5	27.9
5.5 a (hedge plot)	83.50	73.0	43.8
6.5 a (hedge plot)	51.00	150.2	46.0
6.5 a (plantation)	45.40	121.0	32.9

Conclusions

Larix olgensis can be easily rooted outside using an automatic mist system. The age of the ortet is a main factor that may affect the cuttings rooting. Cutting's location on the tree is the next factor. Treatment with plant hormone is able to stimulate rooting of the cuttings from older trees [3, 4].

The optimal time for seedling transplanting of *Larix olgensis* is in the middle of August. By using ABT(3) in 100 PPM and chalete rare-earth molybdenum compound (300×10^{-6}), the survival seedlings can be improved to 91.57%. In order to enhance adaptability of the rooting cuttings to the soil environment, it is better to reduce irrigation amount before transplanting.

It is necessary to produce the number of cuttings needed for operational planting by setting up the hedge plot of *Lair olgensis*. Also, its rooting ability can be maintained to keep the trees in a more juvenile stage though method such as hedging. Hedges in 5 years old can produce 91.75 shoots per tree, exceeding the control to 152.2%.

References

1. John A. 1979. Propagation of Hybrid Larch by Summer and Winter Cutting. Silvae Genetica. 28. 5-6

2. Morgenstern E. K. 1994. Methods for Rooting of Larch Cuttings and Application in Clonal Selection. The Forestry Chronicle. 63 (3): 174-178

3. Wang Qiuyu et al. 1995. Study on Cutting Propagation Technique of *Larix olgensis* and Rooting Mechanism of the Cuttings. China Forestry Publishing House. Proceeding of Forest Tree Improvement in the Asia-Pacific Region. 226-231

4. Wang Qiuyu et al. 1996. Propagation of *Larix olgensis* by Softwood and Hardwood Cuttings. Journal of Northeast Forestry University. 24 (1): 9-16

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